STATE OF CALIFORNIA

AIR RESOURCES BOARD

QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES FOR AIR QUALITY MONITORING

APPENDIX L

NEPHELOMETER

MONITORING AND LABORATORY DIVISION

JANUARY 1998

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STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES FOR AIR QUALITY MONITORING

APPENDIX L.1

STATION OPERATOR'S PROCEDURES FOR NEPHELOMETER

MONITORING AND LABORATORY DIVISION
JANUARY 1998

L.1.0 GENERAL INFORMATION

The Meteorology Research, Inc. (MRI) Integrating Nephelometer measures the scattering coefficient of light caused by suspended particles in ambient air. The scattering coefficient (bscat) is then used as an indicator of relative visibility. The bscat may also be related to the level of particulate concentration. The formula for estimating mass concentration of particles is:

$$\text{Mass (g/m3)} = 0.38 \text{ bscat}$$

L.1.0.1 SYSTEM OPERATION - The MRI Model 1550B consists of an Optical Assembly, Electronic/Control Package, Air Blower/Filter Unit and an Air Sample Heater.

During monitoring, the blower draws ambient air continuously through the optical assembly. A photomultiplier tube is located at one end of the optical assembly facing a light trap and a flashlamp. The photomultiplier tube detects the light scattered from suspended particles in the air sample stream and the resulting current pulse is fed to an integrator circuit. A reference phototube located under the flashlamp senses each flash directly, and the resulting current pulse is fed to another integrator circuit. The output from the two integrators is fed into a divider circuit whose output is the ratio of the pulse of the photomultiplier to that of the reference phototube. The output of the divider circuit is fed to output circuitry, resulting in an analog output voltage which is applied to a panel meter and to a strip chart recorder and/or data acquisition system. This electronic output represents the scattering coefficient of light caused by the particulate matter in the air.

For detailed description of the optical assembly, refer to the Theory of Operation Section and Schematic Diagram 1432700 in the manufacturer's instruction manual.

L.1.0.2 PHYSICAL DESCRIPTION - The MRI Nephelometer Optical Assembly is an aluminum tube 44" long and 4" in diameter. It is fitted with “L” shaped inlet and exhaust openings. The electronic/control package (19" wide x 7~ high x 11-deep) contains the integrator circuits, amplifters, power supplies, and other necessary electronic components. The blower/filter unit (8" wide x 9" high x 11" deep) contains a blower and a filter pump. The blower works as an exhaust fan and continuously draws ambient air through the sampling chamber at a rate of approximately 5 cubic feet/minute. The filter pump continuously routes enough air through a filter into the optical assembly in order to reduce particulate

deposition on the photomultiplier lens and in the calibration chamber. An ambient air sample heater surrounds the inlet tube to remove excess moisture and maintain a humidity of less than 60 percent. The air sample heater consists of an insulted tubular heating chamber 24" long and 2.5" in diameter. Figure L.1.0.1 shows a typical MRI Integrating Nephelometer.

L.1.0.3 CAUTIONS

1. During the initial set-up, avoid sharp bends in the sample line on which sedimentation of suspended particles may collect.

2. To avoid electrical shock, use proper procedures when working on the electronic/control package.

3. During sampling, keep water out of the optical assembly to assure that pollutant particles, not water droplets, are causing scattering of light. Water in the optical assembly may severely damage the interior finishes.

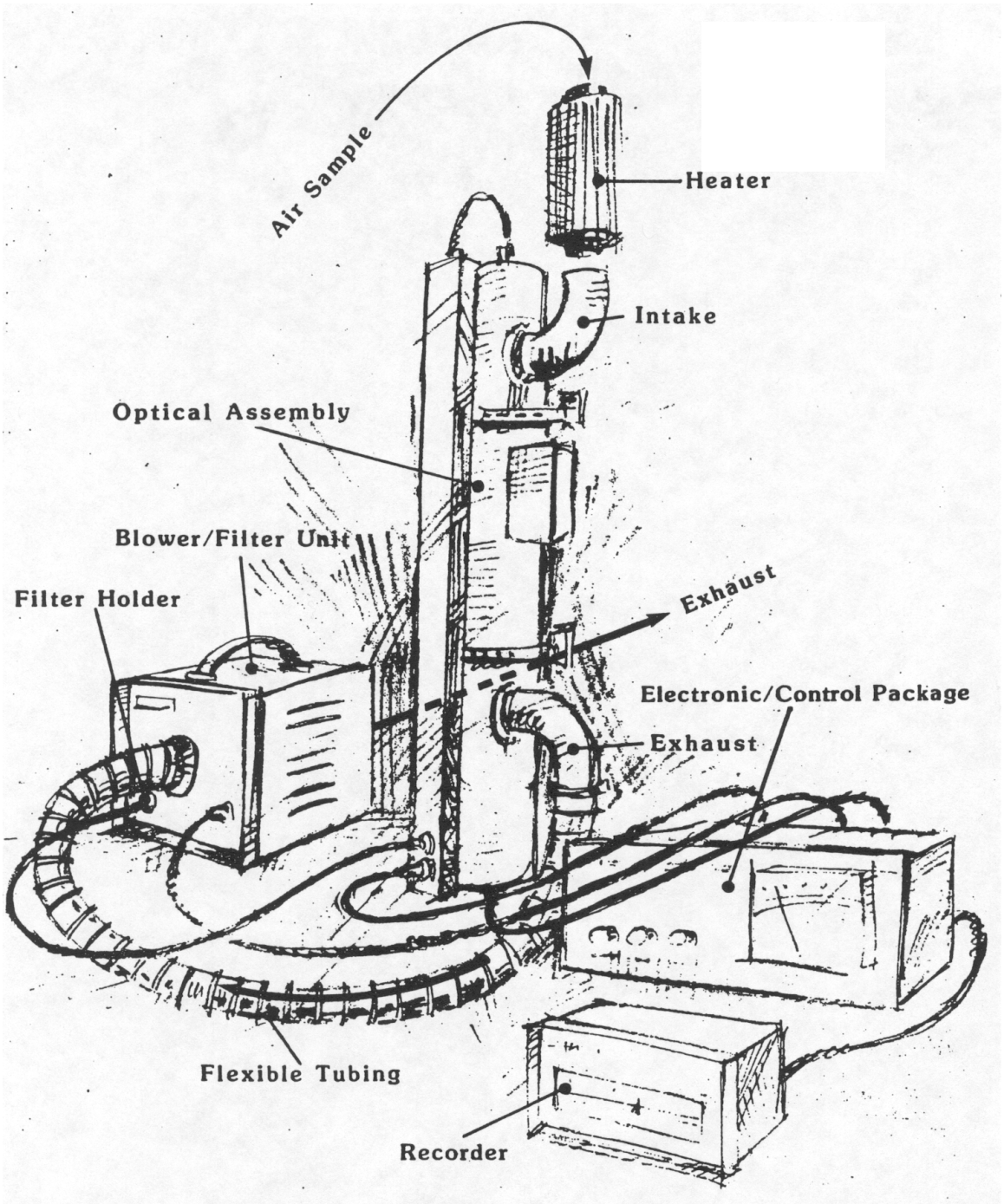

Figure L.1.0.1
MRI Nephelometer

L.1.1 INSTALLATION PROCEDURE

L.l.l.l PHYSICAL INSPECTION - Unpack the Nephelometer and check for external shipping damage. Verify the analyzer is complete upon receipt. Open the Nephelometer electronic and optical sections and check it for loose or damaged components.

L.l.l.2 INITIAL SET-UP

1. Hold the optical assembly in a vertical position with the inlet pipe up and clamp or bolt to the side of an instrument rack, wall, or other stable structure.

2. Install the electronic/control package in the standard 19" racks.

3. Connect the necessary plumbing, power cord, and the recorder signal cable (see Figure L.1.1.1 for plumbing details), as described below:

    a. Connect the flexible hose from the exhaust tube of the optical assembly to the blower/filter unit. Clamp both ends of the hose.

    b. Connect the two cables from the electronic/control package to the optical assembly.

    c. Connect the cable from the electronic/control to the blower/filter unit.

    d. Connect the plastic filtered air tubing (Poly-Flo) from the blower/filter unit to the optical assembly.

    e. Connect electronic/control package power cord to a 115 VAC power source.

    f. Connect recorder cable to the rear of electronic/control package.

4. Connect the air sample heater to the Nephelometer as described below:

    Air Sample Heater Hook-Up - The intake air sample heater is required to ensure that the relative humidity of the ambient air sample is maintained at less than 60 percent. This assures that pollutant particles, not water droplets, are causing scattering of light. To install, place the heater

between the ambient air sample hose and the Nephelometer intake. Connect the ambient air sample hose to the air sample heater end as shown in Figure L.1.1.2 and clamp the sample hose. Connect the other end of the air sample heater to the Nephelometer intake via a flexible hose. Clamp or tape the flexible hose ends. Secure the air sample heater in place using its "T"- bar plates. Connect the heater power cord (three-prong plug) to the J-2 on the rear plate of the electronic/control package.

NOTE: Do not connect the heater to a separate wall outlet. The heater operates only when the Nephelometer is in the "RUN" mode. Connect the heater tap so that the thermal switch is on the downstream end of the tube being heated.

5. Perform routine service checks. Refer to Section L.1.2.3 for details.

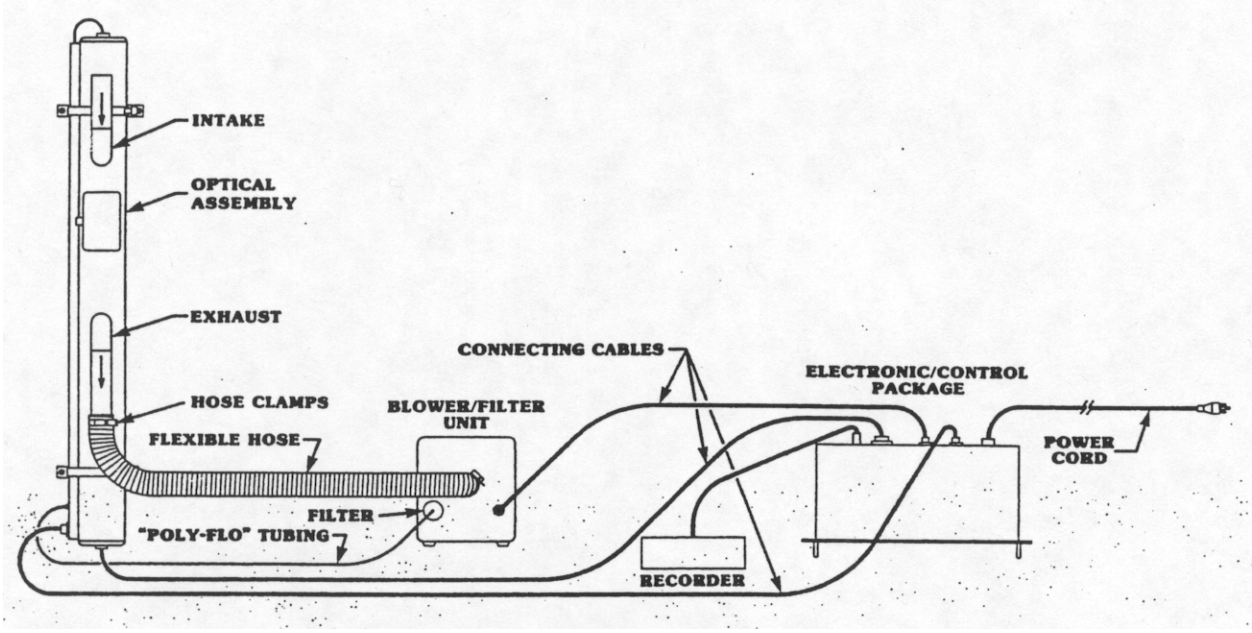

Figure L.1.1.1
Plumbing Details

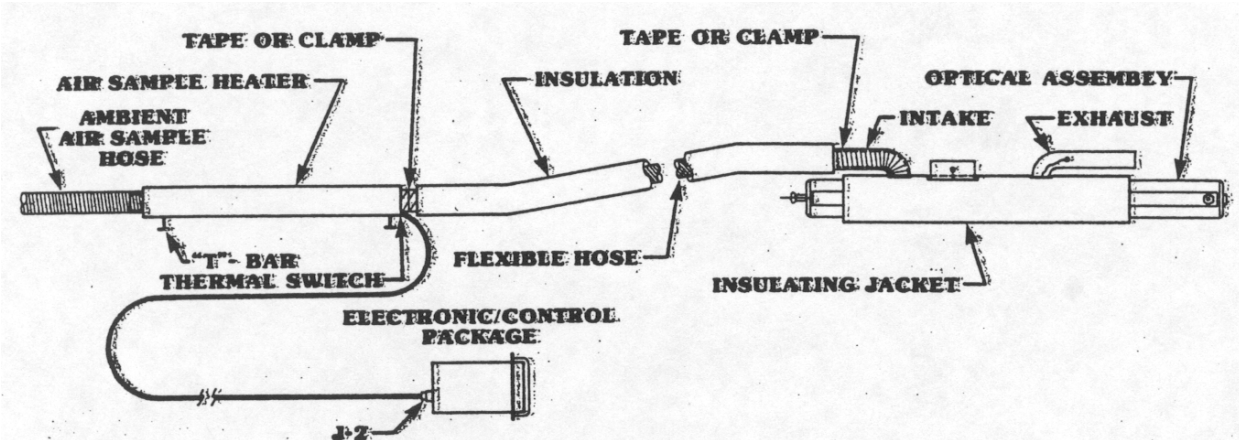

Figure L.1.1.2
Air Sample Heater Hook-Up

L.1.2 ROUTINE SERVICE CHECKS

L.1.2.1 GENERAL INFORMATION - Perform the following checks at the intervals specified in the Maintenance Schedule (Table L.1.2.1). Checks may be performed more frequently, but should be performed at least at the prescribed intervals. The Monthly Quality Control Maintenance Checksheet (Figure L.1.2.1) should be completed and forwarded to your supervisor.

L.1.2.2 DAILY CHECKS - Daily checks are primarily visual checks to assure data are not lost due to a burned out flashlamp or a pump/blower failure. Note and investigate any unusual pump or blower noises. A new noise or absence of a familiar noise may indicate a malfunction.

L.1.2.3 WEEKLY CHECKS

1. Check the operation of the air sampling heater and correct as necessary.

2. Remove the flexible hose at the Nephelometer inlet and close it off with a clean paper towel. Secure the paper towel with a rubber band. Also, remove the exhaust hose and close Nephelometer outlet with a rubber plug. Perform A-C/AIR calibration check as follows:

    a. Set the “Range” switch to the “A-C” scale and the “Function” switch to the “AIR” mode.

    b. Open the front panel on the electronic/control package and set the “Flash/Sec” switch to one per second and the “Time Constant” switch to 100. Close the panel.

    c. Allow 20 minutes of operation for the filtered air to purge the optical chamber.

    d. Record a stable 10-minute trace on the strip chart recorder.

    e. Record the above strip chart reading under A-C/AIR in the “As Found” column on the Monthly Quality Control Maintenance Check Sheet.

    f. If the “As Found” reading is not 0.23 on the panel meter, unlock and adjust the “Background” potentiometer until a stable trace reading of 2.3 chart divisions are recorded on the strip chart.

NOTE: The 0.23 panel meter indication represents the instrument's response to air at sea level, assuming standard temperature and pressure. Faster instrument response can be obtained by adjusting the "Background" potentiometer with the "Time Constant" switch set to the "Test" position.

g. Set the "Range" switch to the A x 10 - C x 0.1 scale and check for a zero trace. Adjust R-25 on the amplifter card to obtain a zero trace on the recorder.

h. Set the "Range" switch to A-C scale and check for a strip chart trace of 2.3. Use the background potentiometer on the front panel, if necessary, to adjust for a stable trace reading of 2.3.

3. Perform the A-C/CAL calibration check as follows:

a. While leaving the range switch in the "A-C" position, set the "Function" switch to the "CAL" mode.

b. Allow the trace to stabilize on the strip chart recorder.

c. Record the above strip chart reading under A-C/CAL in the "As Found" column on the Monthly Quality Control Maintenance Check Sheet.

d. If the "As Found" reading is other than +5 percent of the reference calibration number recorded on the inside of the electronic/control package, unlock and adjust the "Gain" potentiometer on the front panel until a stable trace corresponding to the reference calibration reading is obtained on the strip chart recorder.

NOTE: The "As found" A-C/CAL value may have been affected by background adjustment in step 2f (Section L.1.2.3). Recheck A-C/AIR and A-C/CAL values after background and gain adjustments, respectively. Readjust if necessary.

e. Record reference calibration reading under A-C/CAL in the "After Gain Adjustment" column on the Monthly Quality Control Maintenance Check Sheet.

4. Reconnect the flexible inlet and exhaust hoses.

5. Set the "Function" switch to the "RUN" position.

L.1.2.4 MONTHLY CHECKS - Replace the clean air filter located in the filter holder on the blower/filter unit. Record the replacement date on the Monthly Quality Control Maintenance Check Sheet. Replace clean air filter as necessary in air environments containing excessive dust particles.

Check all connections for tightness and check the condition of hoses and cables. Replace and/or clean as necessary.

L.1.2.5 BIMONTHLY CHECKS (every two months) - Open and inspect the optical assembly. Clean, if necessary, and record the date on the Monthly Quality Control Maintenance Check Sheet.

Perform HFC 134a calibration. Adjust the "gain Potentiometer" for desired value "What CAL Should Be" (see details in Section L.3.1.2). Record new CAL number on the sticker inside the front panel of electronic/control package. Also, record the calibration date and freon calibration number on the Monthly Quality Control Maintenance Check Sheet.

L.1.2.6 SEMIANNUAL CHECKS - Remove the cover from the blower/filter unit and oil (SAE 20) the exhaust blower motor. Add one drop of oil in each of the two oil holes on the blower motor.

Inspect and clean flexible inlet and exhaust hoses.

Table L.1.2.1

Maintenance Schedule for the MRI Nephelometer

PARAMETER	DAILY*	WEEKLY	MONTHLY	BI-MONTHLY**	SEMI-ANNUALLY
Flash Lamp Operating	X				
Clean Air Pump & Blower Operating Properly	X				
A-C/AIR Check		X			
A-C/CAL Check		X			
Heater Operating		X			
Replace Clean Air Filter			X		
Check Connections and Condition of Hoses and Cables			X		
Inspect & Clean Optical Assembly as Needed				X	
Perform Calibration				X	
Lubricate Blower Motor					X
Clean Flexible Hoses					X

* Or each day the site operator is present

** Clean optical assembly more often in air environments containing excessive dust particles or if there are signs of spiderwebs, insects, etc., in the optics. Bimonthly means every two months.

Note: Perform HFC 134a calibration whenever photomultiplier tube, flashlamp, or any of the boards in the electronic/control package are replaced.

CALIFORNIA AIR RESOURCES BOARD
MONTHLY QUALITY CONTROL MAINTENANCE CHECK SHEET
MRI INTEGRATING NEPHELOMETER

Station Name: _____ Month/Year: _____

Station Number: _____ Technician: _____

Nephelometer Property Number: _____ Agency: _____

OPERATOR INSTRUCTIONS:

1) *DAILY CHECKS: Flash lamp operating; clean air pump and blower operating properly.

2) WEEKLY CHECKS: Check Air Sample Heater for operation, correct malfunction if necessary. Record weekly calibration checks data below.

	WEEKLY CALIBRATION CHECK (Chart Divisions)				
	A-C/AIR		A-C/CAL		
DATE	As Found	After Background Adjustment	As Found	After Gain Adjustment	Heater Operation Checked?
		2.3			
		2.3			
		2.3			
		2.3			
		2.3			

3) MONTHLY CHECKS: Replace clean-air filter on the blower/filter unit. Date last replaced _____. Check connections for tightness and also check condition of cables and hoses. Replace and/or clean as necessary.

4) **BIMONTHLY CHECKS: Open and inspect optical assembly, clean if necessary. Date last cleaned _____. Perform HFC 134a calibration and adjust GAIN potentiometer for desired value "What CAL should be." Record new CAL number on the sticker inside the panel. Date last performed _____. HFC calibration number _____.

5) SEMI-ANNUALLY: Remove the cover from the blower/filter unit and oil (SAE 20) the exhaust blower motor. Add one drop of oil in each of the two oil holes on the motor. Date last oiled _____.

DATE	COMMENTS OR MAINTENANCE PERFORMED

* or each day the site operator is present.

** Clean optical assembly more often in air environments containing excessive dust particles or if there are signs of spiderwebs, insects, etc., in the optics. Bimonthly means every two months.

NOTE: Perform HPC 134a calibration whenever photomultiplier tube, flashlamp or any of the PCB boards are replaced.

REVIEWED BY: _____ DATE: _____

ADD-49 (12/84)

Figure L.1.2.1
Monthly Quality Control Maintenance Check Sheet

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES FOR AIR QUALITY MONITORING

APPENDIX L.2

ACCEPTANCE TEST PROCEDURE FOR NEPHELOMETER

MONITORING AND LABORATORY DIVISION

JANUARY 1998

L.2.0 PROCEDURE

L.2.0.1 GENERAL INFORMATION - Before beginning an acceptance test of the Nephelometer, read the manufacturer's operating and service manual. Then, initiate an instrument log book and an Acceptance Test Mini-Report (Figure L.2.0.1).

L.2.0.2 PHYSICAL INSPECTIONS - Unpack the Nephelometer from its shipping containers and check for shipping damage. Report any damage observed to your supervisor and record any defects on the Acceptance Test Mini-Report. Perform the following checks:

1. Verify that the Nephelometer is complete upon receipt as per purchase order specifications.

2. Open the Nephelometer electronics and optical sections and check for loose or damaged components.

3. Check the AC power inlet receptacle and power cord, be certain that the Nephelometer power cord and plug are three-wire, with ground terminal.

L.2.0.3 INITIAL PERFORMANCE CHECKS - Set up the Nephelometer by following the initial set-up procedure (Section L.1.1.2). Perform the following checks:

1. Set the 'Time Constant" switch to 'Test' position and the "Flashes/Sec" switch to the one-second position. Turn the "Function" switch from "OFF" to the "RUN" mode. Check the front panel meter movement and check that the flashlamp is flashing at one-second intervals.

2. Remove the filtered air plastic tubing (Poly-Flo) from the optical assembly. Turn the "Function" switch to the "AIR" mode and check for a small airflow with finger on the open end of the plastic tubing. Reconnect the plastic tubing to the optical assembly.

3. Remove the exhaust hose at the optical assembly. Check the position of the air exhaust valve. The position of the valve can be observed by looking up the exhaust port on the optical assembly. The exhaust valve should be open only when the "Function" switch is in the "RUN" or "OFF" position. Check for suction at the exhaust tube while the Nephelometer is operating in the "RUN" mode. Reconnect the exhaust tube at the optical assembly.

4. Set the "Function" switch to the "CAL" mode and check for upscale meter movement. Note the "cluck" noise when the light trap shutter goes to open position. The shutter should be open only when the "Function" switch is in the "CAL" position. Set the "Function" switch back to the "AIR" position.

5. Connect the air sample heater AC power cord to the back of the electronic/control package, set the "Function" switch to the "RUN" position, and check the heater operation.

L.2.0.4 OPERATION TESTS - Perform the following operational tests and record the results on the strip chart and the Acceptance Test Mini-Repon (Figure L.2.0.1) as a permanent record of the tests performed (comments in ink). File the charts and the test report in the Air Quality Surveillance files under the assigned ARB property number.

1. Calibration - Perform HFC 134a calibration on the Nephelometer (follow procedure described in Appendix L.3).

2. Zero (A-C/AIR) and Span (A-C/CAL) Repeatability Tests - Complete the initial performance checks (follow procedure in Section L.2.0.3). Perform zero and span calibration checks as follows:

   Remove the air sample hose at the Nephelometer inlet and close the inlet tube with a clean paper towel. Remove the exhaust hose and close the Nephelometer outlet with a rubber plug. Set the "Flash/Sec" switch to 1 per second. Set the "Time Constant" switch to "Test". Set the "Range" switch to the "A-C" scale and the "Function" switch to the "AIR" mode. Allow the unit to stabilize for 30 minutes.

   Verify that the output is +0.23 on the front panel meter, and 0.0 on the other two scales. If the output is other than +0.23, unlock the "Background" potentiometer following adjustments. Recheck zero in the other two ranges and adjust R-25 on the amplifier card if not zero.

   Set the "Function" switch to "CAL". Verify that the output reading is within +5 percent of the reference calibration reading listed on the sticker attached to the 115-V safety shield covering the back side of the "Function" switch. If the output reading is not within +5 percent of the reference calibration reading, unlock the "Gain" potentiometer and adjust the meter until the reference calibration number agrees. Recheck clean air

value of 0.23 and adjust, if necessary. Recheck CAL if “Background” is adjusted. The Nephelometer is now aligned and ready for testing.

NOTE: If the calibration check adjustments cannot be completed satisfactorily, refer to the troubleshooting section in the manufacturer's instruction manual.

Set the “Time Constant” switch to 100, “Flash/Sec” switch to 1 per second and “Range” switch to the “A-C” scale. Turn the “Function” switch to the “AIR” position. Record the zero (A-C/AIR) trace on the strip chart and mark it accordingly. At the end of a 24-hour period, set the “Range” switch to “B-D” scale and record response trace for 30 minutes. Turn the “Function” switch to “CAL” and record approximately 30 minutes of B-D/CAL trace on the strip chart. Turn the “Range” switch to A-C scale and record approximately 30 minutes of trace. Turn the “Function” switch to “AIR” and continue recording for an additional 24-hours. Record an additional 30 minutes zero and span response trace on the “A-C” and “B-D” scales. Repeat A-C/AIR for 24-hours test of zero and span traces of “A-C” and "B-D" scales with 30 minutes recorder strip chart traces for each.

The following performance specifications should be met:

a. The zero and span drifts should be less than +1 percent of full scale for 24 hours on each scale.

b. The zero and span drifts should be less than +2 percent of full scale for 72 hours on each scale.

3. Temperature/Voltage Tests - Place the Nephelometer in the environmental chamber and connect the power cord to the variable voltage power strip. To keep the optics clean, place a paper towel over the Nephelometer inlet tube, securing it with a rubber band. Close the Nephelometer outlet with a rubber plug. Set the “Time Constant” switch to 100, “Flash/Sec” switch to 1 per second and “Range” switch to the “A-C” scale. Set the “Function” switch to “AIR” position. Record the Nephelometer output on a strip chart recorder. Perform a standard temperature/voltage run (Thermotron Program #7) and record the output trace. Repeat the standard temperature/voltage test with the “Function” switch set to “CAL” position and record the output response. The following performance specifications should be met:

a. If there is a ±10 VAC change in voltage from 115 VAC, the zero (A-C/AIR) response shall not change more than ±1 percent of full scale and the span (A-C/CAL) shall not change more than +2 percent of full scale.

b. If there is a ±10 percent C change in temperature from 25°C, both the zero and span responses shall not change more than ±2 percent of full scale.

4. Final Review - If the tests are satisfactory, complete an equipment relocation notification sheet recording pertinent information such as reference calibration value, flashlamp and PMT voltages, etc., in the log book and on the Acceptance Test Mini-Report. Record equipment numbers, date completed, and other appropriate information. The Nephelometer is now ready for field use.

METEROLOGY RESEARCH, INC., NEPHELOMETER
ACCEPTANCE TEST, "MINI-REPORT"

Date _____ Make and Model No. _____ Serial No. _____
By _____ ARB No. _____ Reviewed By _____
Date of Acceptance _____

	Passed	Failed	Final OK*
I. PHYSICAL INSPECTIONS			
A. Checked for shipping damage……			
B. Checked for loose components……			
C. Sampler complete upon receipt……..			
D. Checked sampler power cord…….			
II. INITIAL PERFORMANCE CHECKS			
A. Checked movement of panel meter……			
B. Checked flash lamp flashing intervals……			
C. Checked clean-air flow from the filter pump……..			
D. Checked position of exhaust valve…….			
E. Checked operation of light trap shutter……..			
F. Checked air sample heater operation……..			

III. OPERATIONAL TESTS (Attach Charts)	% FS Dev.				
	Zero	Span			
A. 24-Hour Drift……...					
B. 72-Hour Drift……...					
C. Temperature and Voltage Variation					
Zero and Span Shifts: 35°C 115 V					
35°C 125 V					
35°C 105 V					
15°C 115 V					
15°C 125 V					
15°C 105 V					

IV. SPECIAL TESTS

V. COMMENTS/MAINTENANCE PERFORMED

* Indicate corrective action taken.

Figure L.2.0 1
MRI Nephelometer Acceptance Test Mini-Report

STATE OF CALIFORNIA

AIR RESOURCES BOARD

AIR MONITORING QUALITY ASSURANCE

VOLUME II

STANDARD OPERATING PROCEDURES FOR AIR QUALITY MONITORING

APPENDIX L.3
CALIBRATION PROCEDURE FOR NEPHELOMETER

MONITORING AND LABORATORY DIVISION
JANUARY 1998

L.3.0 OVERVIEW

L.3.0.1 THEORY- Calibration is performed bimonthly (every two months) with HFC 134a. The output of the Nephelometer is directly proportional to the scattering of light by the suspended particles in the air sample. The light scattering values for HFC 134a and clean air provide the high and low calibration points, respectively. Small circles on the A-Scale of the panel meter indicate these two points.* Since the output of the Nephelometer is linear, these two points are sufficient for an accurate adjustment. The third point, called the reference calibration point, is recorded behind the front panel meter door after each bimonthly HFC 134a calibration.

L.3.0.2 APPARATUS

1. HFC 134a can with flow restrictor
2. HFC 134a filter and five feet of plastic (Poly-Flo) tubing
3. Common screwdriver
4. Two tapered 1 3/4"-1 1/2" diameter rubber plugs - one solid and one with 1/4" teflon line for venting HFC 134a during calibration
5. Adjustable wrench
6. Pencil and paper (used for calculation of what CAL should be)

---

* Clean air = 0.23 and HFC 134a = 1.68 panel meter readings
When using strip chart recorders, the values are 2.3 and 16.8, respectively.

L.3.1 CALIBRATION

See Figure L.3.1.1 to set up Nephelometer for calibration.

L.3.1.1 NEPHELOMETER WARM-UP

1. Initially set up Nephelometer (refer to Section L.1.1.2).

2 Disconnect air intake and exhaust hoses.

3 Cover optical assembly inlet tube with a folded, clean, white paper towel and secure it with a rubber band.

4 Insert the 1 3/4"-1 1/2" diameter solid tapered rubber plug in the end of the outlet tube.

5 Set “Time Constant” to 100.

6 Set “Flash/Sec” switch to 1.

7 Set “Range” switch to the “A-C” scale.

8. Turn “Function” switch from “OFF” to “AIR” mode.

9. Allow a one-hour warm-up. This will assure complete purging of the optical assembly sampling chamber.

L.3.1.2 CALIBRATION

1. Set “Time Constant” to “Test” position.

2. Leave “Flash/Sec” switch on 1, “Range” switch on “A-C” scale, and “Function” switch on “AIR” mode.

3. After one minute, unlock the “Background” potentiometer and adjust the clean air calibration to read 0.23 on “A” scale of the panel meter. Relock the potentiometer.

4. Check the zero trace on the “Ax10-Cx0.1” scale. If a zero adjustment is necessary, adjust R-25 on the amplifier card (blue color card) in the electronic/control package to obtain an acceptable trace on the recorder.

If adjustment is necessary, recheck clean air value of 0.23 on "A" scale. Check both scales until no adjustments are required.

5. Turn the "Function" switch to the "CAL" mode. Turn the "Time Constant" switch to the 100 position after the meter pointer advances upscale. Obtain a stable 15-minute trace on the strip chart recorder. On the sheet of paper set aside for calculations, record the chart reading and label it as "CAL Is". This is your reference calibration reading.

6. Turn the "Function" switch to the "AIR" mode. Allow enough time for trace to return to the background level (0.23).

7. Disconnect the clean air line at the filter on the blower/filter unit. Connect the clean air line to the filter on a HFC 134a container.

   NOTE: The HFC 134a container outlet valve should contain a flow restrictor to prevent fogging of the optical assembly. If the "HFC 134a Is" response goes *off* scale, HFC 134a gas is entering the optics too fast or the restrictor valve may be missing.

8. Connect the 1 ¾"-1 ½" diameter tapered rubber plug with the vent line to the optical assembly inlet port so that the HFC 134a used to test response can be vented.

   NOTE: HFC 134a WILL CONTAMINATE THE AADCO HYDROCARBON CATALYST, SO CARE SHOULD BE TAKEN TO PROPERLY VENT THE HFC 134a OUT OF THE STATION.

9. Open the valve on the HFC 134a container and fill the optical assembly sampling chamber for approximately 15 minutes or until the stable trace is recorded. Record the "HFC 134a Is" reading on your calculation sheet.

10. Turn the HFC 134a valve off and reconnect the clean air line to the blower/filter unit.

11. Allow the optical assembly 30 minutes for purging. Allow enough time for trace to return to the background level (2.3 on the strip chart recorder).

12. Disconnect the vent line from the optical assembly inlet and cover the inlet with a folded white paper towel and secure with a rubber band.

13. Recheck clean air point of 0.23 panel meter and 2.3 strip chart readings and adjust “Background” potentiometer, if necessary.

14 Turn “Function” switch to the “CAL” position and recheck the “CAL Is” response (reference calibration reading obtained in Step #5).

NOTE: This “CAL Is” recheck will verify “GAIN” potentiometer was not accidentally moved.

15. Use the following equation to calculate “CAL Should Be” by substituting values for “HFC 134a Is” and “CAL Is” (see Steps 5 and 9).

$$\text{CAL Should Be} = \frac{(\text{CAL Is})\ (1\ 68)}{\text{HFC 134a Is}}$$

$$\frac{\text{HFC 134a Is}}{\text{HFC 134a Should Be}\ (1.68)} = \frac{\text{CAL Is}}{\text{CAL Should Be}\ (X = ?)}$$

NOTE: Panel meter = 1.68 strip chart = 16.8

16. With “Function” switch in “CAL” position, adjust the “GAIN” potentiometer to its mid-adjustment point and adjust R-13 (PMT voltage) on the high and low voltage card (orange color card) to approximately what “CAL Should Be".

17. Turn the “Time Constant” switch to the “Test” position, the “Function” switch to the “AIR” position and adjust the background potentiometer to reset clean air value of 0.23 on the panel meter and 2.3 on the strip chart.

18. Check for zero on the “Ax10-Cx0.1” range and adjust as required.

19. Recheck the background on the “A-C' range. The background should be 0.23 on the panel meter and 2.3 on the strip chart. If adjustments are required, check in the “CAL” mode and adjust “GAIN” potentiometer as required. Check the background again if it was necessary to make adjustments in the “CAL” mode.

20. Set the “Function” switch to the “CAL” position, the “Range” switch to the B-D and the “Time Constant” switch to 100. Obtain a stable 15-minute trace on the strip chart recorder.

21. Turn the “Function” switch to “AIR” and obtain a stable 15-minute trace on the strip chart recorder.

22. Turn the “Range” switch to “A-C” scale and obtain a 15-minute trace on the strip chart recorder.

    NOTE: Traces should hold within one chart division when stabilized

23. Nephelometer is now ready for sampling.

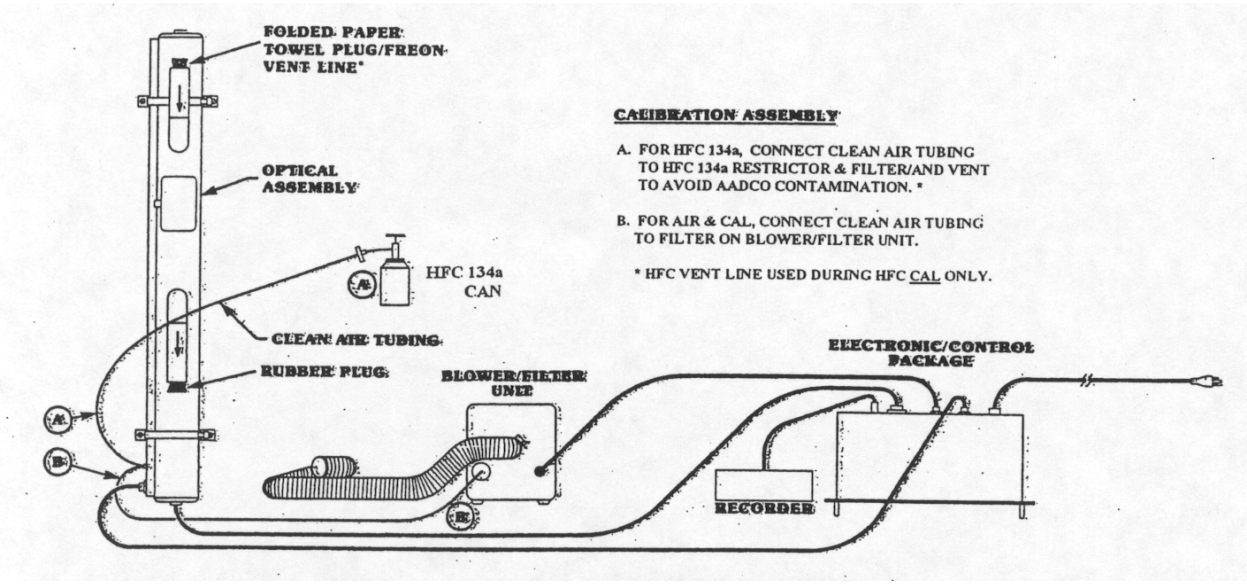

Figure L.3.1.1
Calibration Assembly